

PLATE XII.

Paronella insignis (continued).

- Fig. 81. The right foot of the third pair of legs, seen from the outer aspect.
82. The right mucro seen from the outer aspect.

Sminthurides appendiculatus, sp. n.

- Fig. 83. The left antenna seen from the inner side.
84. The left hind foot, inner side.
85. The left foot of the first pair of legs seen from the inner side.
86. The right mucro seen from its outer aspect. *d. i. l.*, dorsal inner lamella;
d. o. l., dorsal outer lamella; *v. l.*, ventral lamella.

Pseudocyphoderus annandalei, gen. et sp. n.

- Fig. 87. Foot of third pair of legs.
88. The furcula viewed from the dorsal side. *t. s.*, terminal scale.
89. The left dens and mucro from the outer side. *t. s.*, terminal scale.

Cyphoderus simulans, sp. n.

- Fig. 90. The left foot of the second pair of legs.
91. The left mucro seen from its outer aspect.

8. Ontogenetical Transformations of the Bill in the Heron
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(Plate XIII.*)

The birds of the subfamily Ardeinæ are known to have a conical, pointed, spear-shaped bill with a simple rhamphotheca. The curious fact that these features are acquired only in a late post-embryonic stage seems to have attracted little attention. I have been able to trace a gradual development of these features in a series of embryos and young birds of *Ardea cinerea*, collected and generously presented to me by one of my friends, Mr. J. G. Sobolev, of Moscow.

In an embryo, in which the feather-papillæ on the back have just assumed a conical shape (length of the gape about 12 mm.), the bill is straight and rather slender, the tip of the upper jaw is conspicuously swollen (not only owing to the presence of the so-called egg-tooth), and the culmen is *concave*; a furrow runs from the nostril to the base of the swollen tip (Pl. XIII, fig. 1).

In an embryo about one day before hatching (length of gape 22 mm.) the form of the bill has already changed; it is thicker, its swollen tip is not so prominent and is slightly hooked, and the culmen is not so concave. The horny sheath of the bill is manifesting itself; the covering of the tips of both jaws is thicker and more solid, and the covering of the tip of the upper jaw is marked off by a raised area; a furrow anterior to the nostril, and a space

* For explanation of the Plate see p. 126.

of softer and finely wrinkled skin between the eye and the nostril divide the covering of the upper jaw into a dorsal and a paired lateral plate. The covering of the mandibular rami is marked by the presence of some parallel oblique ridges; these are perhaps still more conspicuous just at the time of hatching, but quickly disappear afterwards (fig. 2).

One day after hatching (length of gape 25 mm.) the bill is longer and conspicuously thicker, and the swelling of the tip has almost disappeared. The covering of the tip of the upper jaw is still marked off by its texture and relief, and the tip-covering of the mandible is marked off by two irregular crack-like furrows as well as by its solid texture. The division between the upper and lateral plates of the upper mandible is plainly visible (fig. 3).

About three days after hatching (length of gape 32 mm.) the bill has nearly assumed its conical shape, but is still relatively short and thick and the tip is still conspicuously hooked. The horny covering of the mandible-tip is still marked off by irregular furrows; in the upper jaw it is no more distinct; the lateral furrows before the nostril, dividing the upper and paired lateral horny plates, are still clearly visible (fig. 4).

These changes seem to deserve attention on more than one ground. The simple rhamphotheca proves to be only a late stage of the compound one, as very clear vestiges of separate pieces are visible in younger stages. In the upper jaw we find a tip piece, a dorsal piece, and a paired lateral piece; in the mandible there are a tip piece and a paired lateral piece. The form of the Ardeine bill proves to be a derivative one. The presence of the tip-hook in the nearest relatives of the Herons, *Scopus* and *Baleniceps*, is hence a primitive feature. In younger stages the shape of the bill, combined with its compound rhamphotheca, recalls very nearly that of a Cormorant, especially of a young one about the time of hatching, and also of the nestling of a Frigate-bird, and of a Pelican about the time of hatching. This points once more to the affinities of the Ardeæ and Steganopodes. The change in shape of the bill in the Ardeinæ is obviously due to their habits of *spearing* their prey instead of *snatching* as most of the Steganopodes do. The peculiar heron-like shape of the bill in the Darter (*Plotus anhingæ*) is connected with the same habits, and the likeness of the bill's shape in the Herons and *Plotus* is to be considered as a case of parallel evolution. The transitory ridges on the mandibular rami recall remotely—by their direction also—the structures so much developed in the Anseres, and also, perhaps, the indentations of the bill in the fossil *Odontopteryx*.

EXPLANATION OF PLATE XIII.

Fig. 1. Bill and head of an embryo of *Ardea cinerea*, length of gape 12 mm. 1×2.

2. The same, one day before hatching. 1×1.75.

3. Young bird, one day after hatching. 1×1.5.

4. The same, about three days after hatching. 1×1.5.